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J. STONE

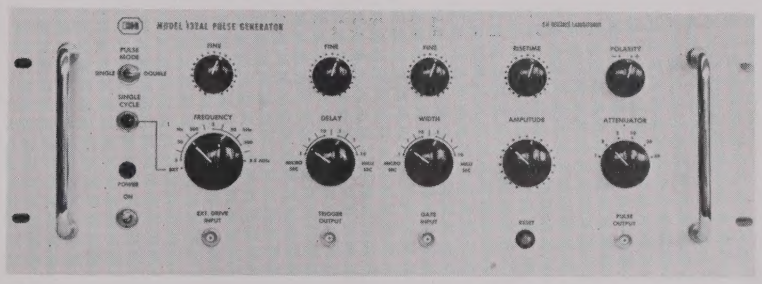
INSTRUCTION MANUAL

model 132 AL
PULSE GENERATOR

E-H RESEARCH LABORATORIES, INC.

E1

MODEL 132AL
PULSE GENERATOR



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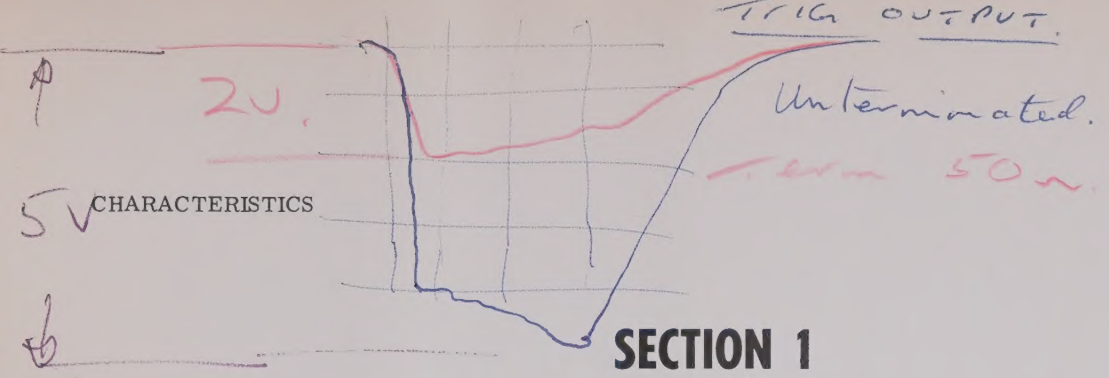
Issued 6-6-68

FOREWORD

Units, abbreviations and prefixes of the International System of Units (SI) are used in this manual. Discrepancies may be noted between the terms used in the text and the instrument panel markings (e. g. ; hertz, kilohertz, megahertz for cps, kilocycles, megacycles, etc.)

The National Bureau of Standards announced its approval of the SI in February 1964, and subsequently the document was adopted by Congress as a national standard.



SECTION 1
CHARACTERISTICS

1-1 GENERAL

The E-H Model 132AL Pulse Generator is designed to provide fast risetime, high current pulses over a broad range of pulse widths and repetition rates. It is suitable for a variety of applications including design problems involving magnetic materials, solid state research, high-speed diode and transistor switching characteristics, and high-current logic and memory circuits. It includes provisions for external driving or gating, provides a trigger for sync purposes, and an output attenuator.

The Model 132AL uses unique latched output circuitry to form the pulse. This method of pulse generation was developed by E-H, and is the reason for the broad capabilities of the Model 132AL. Basically, the latch is a bistable circuit. One stable state is zero output volts, and the other stable state is some positive or negative output that is determined by the AMPLITUDE and POLARITY controls. The latch is triggered from one state to the other by a series of trigger pulses generated by the timing circuits. The latch switches states in typically 10 nanoseconds -- providing the fast risetime pulses specified.

One of the most important features of the latch circuitry is the freedom of all waveform adjustment controls. The output pulse is extremely clean and fast under all conditions of amplitude, repetition rate, pulse width, etc. No "trimming up" of the pulse is required. The only waveform control is the front-panel RISETIME control, which is provided as a convenience to the user.

The timing circuit of the Model 132AL is entirely transistorized to ensure reliable operation indefinitely. The vacuum tube in the output latch is a premium-type that is rated for 10,000 hours life.
In addition, the Model 132AL has been quality constructed to provide long trouble-free operation.

1-2 SPECIFICATIONS

REPETITION RATES: 5 hertz to 3.5 megahertz internally selected by front panel step and vernier controls. The instrument may be externally driven from zero to 3.5 megahertz by a negative 4 volt pulse.

RISETIME: Positive pulse; less than 12 nanoseconds; variable to more than 100 nanoseconds.

Negative pulse; less than 10 nanoseconds; variable to more than 100 nanoseconds.

FALLTIME: Less than 14 nanoseconds, either polarity.

PULSE OUTPUT: The maximum pulse amplitude is 50 volts into 50 ohms, either polarity. An amplitude control and step attenuator provide continuous attenuation to 150:1.

OUTPUT PROTECTION: A resetable circuit is provided to protect the instrument from damage that would otherwise occur if the output load became open circuit under maximum negative going output conditions.

PULSE WIDTH: Less than 100 nanoseconds to more than 10 milliseconds, continuously variable by step and vernier controls.

PULSE DELAY: Less than 100 nanoseconds to more than 10 milliseconds, continuously variable by step and vernier controls.

DUTY FACTOR: The maximum average current out is 250 milliamps. Thus, a 25% duty factor is available at 50 volts amplitude and a 50% duty factor is available at 25 volts amplitude. Automatic limiting prevents overload.

DROOP: 5% or less at 10 milliseconds width.

POLARITY: Output pulses are either positive or negative, but not simultaneous.

TRIGGER OUTPUT: A 4 volt negative pulse, into 2K ohms, approximately 50 nanoseconds wide, is provided for sync purposes.

GATE: A 5 volt negative signal at the GATE INPUT will interrupt the pulse train for the duration of its presence. Input impedance is 2.4K ohms.

DOUBLE PULSE: A front panel switch provides either single or double pulse operation. In double pulse mode, maximum repetition rate is 500 kilohertz for 1 megahertz double pulse rate. Pulses are identical in amplitude, width and polarity. Minimum spacing is approximately three times the pulse width. Spacing is determined by the DELAY control.

SINGLE CYCLE: A front panel pushbutton provides single cycle operation.

DIMENSIONS: Rack Mounted: 19" wide, 7" high. End frames are available for bench use. Weight: 22 lbs. net; 30 lbs. packed; 42 lbs. packed for export.

POWER REQUIREMENTS: 210/250 volts. 50/60 cycles, 200 volt–amperes.

1-3 ACCESSORIES

END FRAMES are available for bench use.

For short pulses, the E-H Model ZT-SERIES PULSE TRANSFORMERS invert the output pulse or match other impedances. Standard impedances are any permutation of 50, 93, 125, 185, or 200 ohms, normal or inverting. Coaxial body with BNC connectors.

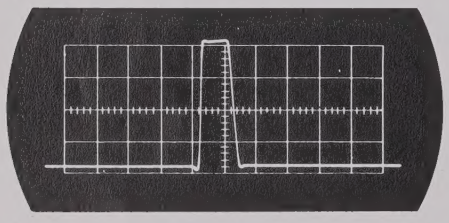
E-H Model RT RISETIME INTEGRATORS. These provide precise risetimes in applications where responses to slow risetimes are important. Standard risetimes of 5, 10, 20, and 100 nanoseconds; other values on special order.

E-H Model 921 VARIABLE DELAY GENERATOR may be used between an external driving source and Model 132AL to obtain precise positioning; or between two or more Models 132AL's. Continuously variable delays from 50 nanoseconds to 100 microseconds.

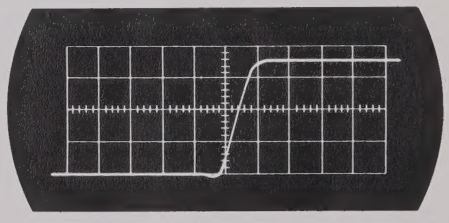
ADDITIONAL ACCESSORIES. The E-H BNC Series accessories are compatible with the E–H Model 132AL and other instruments with BNC connectors. For further accessory information, refer to the data at the back of this manual.

1-4 APPLICATIONS

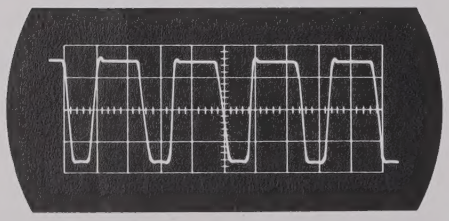
For more information concerning applications, pulse definitions, and pulse generating circuits, consult the E-H booklet entitled "Pulse Generators."



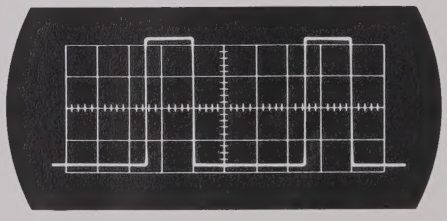
Positive pulse.
10v/cm, 100ns/cm.



Leading edge of positive pulse.
15v/cm, 10ns/cm.



Negative pulse train at max. rep rate.
10v/cm, 100ns/cm.



Positive pulse train.
10 v/cm, 10μs/cm.

Figure 1-1. E-H Model 132AL - Typical waveforms.
(All waveforms observed on a Tektronix Type 545 oscilloscope with Type "L" plug-in.)

SECTION 2
OPERATING INFORMATION

2-1 UNPACKING

Immediately after unpacking the instrument, carefully inspect and evaluate the condition of the shipping container and instrument for evidence of damage that might have occurred during shipment or handling. If damage is noted, the responsible carrier or agency should be promptly notified.

2-2 117 VOLT OPERATION

The internal power supply of the Model 132AL is normally wired for 230 vac operation. Simple rewiring of the transformer primary permits operation at 117 volts. Refer to the schematic diagram at the back of this manual for the proper primary connections.

2-3 OUTPUT IMPEDANCE

The Model 132AL is a current source when the output pulse is negative and a voltage source when the output pulse is positive. Although the impedance at the PULSE OUTPUT connector is not 50 ohms, the instrument is designed to operate into a 50-ohm resistive load. Operation into any other impedance will cause some pulse distortion. Loads with appreciable capacitive or inductive components will have a marked effect on the leading and trailing edges of the pulse.

Use the Model ZT Pulse Transformer to match the Model 132A output to other impedances.

NOTE

For best waveform fidelity, the Model 132AL terminating impedance should always be as close to 50 ohms as possible.

2-4 CABLES, CONNECTORS AND ATTENUATORS

The sharp rising pulse of the 132AL has appreciable frequency components up to 35 megahertz. If any of these high frequency components are attenuated through the use of connectors, cables, or attenuators that do not have a flat frequency response in excess of these frequencies, degradation of the pulse risetime will result. Mismatch effects can also degrade the pulse waveform: consequently, consideration and care must be taken to preserve the quality of the Model 132AL pulse output when coupling it to the system or device under test.

Some of the precautions to observe in coupling the pulse outputs of this instrument are:

1) Always terminate the PULSE OUTPUT of the Model 132AL in a 50-ohm resistive load.

2) If the input impedance of the device or system under test is other than 50 ohms, use an impedance matching device so that mismatch effects will not degrade the pulse waveform.

3) Make sure that all connectors, attenuators, and cables are of proper impedance and have a flat frequency response in excess of 35 megacycles. The GR and Tektronix coaxial attenuators are recommended for use. Only high-quality 50-ohm cable should be used at the Model 132AL BNC PULSE OUTPUT connector such as RG-58C/U or RG-213/U.

2-5 OPERATING CONTROLS AND CONNECTORS

The front panel operating controls, and the function of each, are listed in Table 2-1.

2-6 DUTY FACTOR

The duty factor limitation ensures conservative operation and long life of the output tubes. The duty factor is controlled electronically by monitoring the output current to maintain it at a maximum of 250 milliamperes, average. Effectively, when the duty factor reaches 25 per cent, the amplitude of the output pulse is proportionately decreased as the duty factor is increased.

NOTE

The minimum available pulse width and the duty factor limitation prevents full output at 3.5 megahertz.

Typically, pulse widths of up to 80 per cent of the period can be obtained. Extending the pulse width past the normal period will cause the generator to scale down in frequency, or unusual pulse distortion conditions to appear. At no time, however, can damage occur to the instrument.

TABLE 2-1 OPERATING CONTROLS AND CONNECTORS

ITEM	FUNCTION
POWER	Connect the line cord to a 230 vac 50/60 Hz power source. Turn the POWER switch to ON. The fan will start, and the POWER lamp will light.
FREQUENCY	Pulse repetition frequency is variable in decade steps by the coarse FREQUENCY selector switch. The FINE control serves as a vernier for each range. With these controls, the pulse repetition frequency is continuously variable from 5 Hz to 3.5 megahertz with overlap to adjacent ranges.
DELAY	The DELAY controls vary the time between the trigger pulse and the output pulse. Delay time is variable in decade steps by the coarse DELAY selector switch. The FINE control serves as a vernier for each range. Delay time is continuously variable from 100 nanoseconds to 10 milliseconds, with overlap to adjacent ranges.
WIDTH	The WIDTH controls vary the pulse width; width is variable in decade steps by the coarse WIDTH selector switch. The FINE control serves as a vernier for each range. These controls permit pulse width to be continuously variable from 100 nanoseconds to 10 milliseconds, with overlap to adjacent ranges.
AMPLITUDE	The amplitude of the output pulse is continuously variable over an approximate 3:1 range by the AMPLITUDE control.
ATTENUATOR	The ATTENUATOR provides six step attenuation ratios from 1:1 to 50:1.
POLARITY	The POLARITY switch selects either positive or negative output pulses.
RISETIME	The RISETIME control varies the leading edge risetime for 12 to 100 nanoseconds.
SINGLE CYCLE	The SINGLE CYCLE control provides a single output pulse each time the SINGLE CYCLE button is depressed. To operate, turn the FREQUENCY selector switch to EXT. with the FINE frequency vernier turned fully counterclockwise.
PULSE MODE SINGLE - DOUBLE	The PULSE MODE switch provides for the addition of a second pulse to the normal output pulse train, when required. For SINGLE operation, there is one output pulse during the pulse repetition period; it follows the trigger pulse by the delay time. During DOUBLE operation, a second pulse is added to the output pulse train during the pulse repetition period; the second pulse is approximately coincident with the trigger pulse. The trigger coincident pulse is separated from the original pulse by the delay time. (Continued)

ITEM	FUNCTION
	The DOUBLE pulse mode is operational from 5 Hz to 500 kilohertz, but is inhibited in the highest FREQUENCY range (500 kilohertz to 3.5 megahertz). For best results, the output pulse width should be less than approximately one third of the delay time, and delay time should be less than the pulse repetition period.
EXT. DRIVE INPUT CONNECTOR	Turn the FREQUENCY range selector switch to EXT. and the FINE frequency vernier fully counterclockwise. Apply the negative 4 volt drive signal to the EXT. DRIVE INPUT connector.
GATE INPUT CONNECTOR	A negative 5 volt signal applied to the GATE INPUT will interrupt the output pulse train as long as the signal remains.
PULSE OUTPUT CONNECTOR	The output pulse train is taken from the PULSE OUTPUT connector. The output is designed to operate into a 50-ohm, resistive load. The Model 132AL should always be operated with a load at the output.
TRIGGER OUTPUT CONNECTOR	The TRIGGER OUTPUT connector delivers a negative 5 volt pulse which is useful for synchronizing oscilloscopes or other instruments. For best results, operate with a 50-ohm load, such as a 50-ohm isolation pad or an attenuator.
OUTPUT PROTECTION	If "RESET" neon light is on, check that load is 50Ω. Press neon button to reset.

SECTION 3
PARTS LIST

3-1 ORDERING INFORMATION

Replacement parts may be ordered through your E-H Representative or from the factory. To be certain that you receive the proper replacement parts, always include the following information with your order:

a. Model Number and Serial Number of the instrument on which the replacement parts will be installed.

b. Circuit or Drawing Reference for which each part is intended.

c. E-H Part Number.

This instrument contains several factory-selected components to ensure optimum performance. In no case should a diode or transistor be replaced with one from a different manufacturer, unless it is on the specific recommendation of E-H.

When replacement parts are necessary, be sure to order through the E-H Customer Service organization. In this way, we can best serve you by providing up-to-date factory recommended parts and service information.

3-2 WARRANTY

This instrument is guaranteed to be free from defects in material and workmanship. Our obligation is limited to repairing the instrument should it prove to be defective, upon our examination, within one (1) year after the purchase date. Fuses and batteries are specifically excluded from warranty. Electron tubes, transistors, and diodes are warranted for six (6) months.

For In-Warranty repair of this instrument, contact E-H Research Laboratories, Inc., Customer Service Department, and provide:

a. Instrument Model Number and Serial Number.

b. Full details concerning the nature of the malfunction.

Shipping instructions, or repair information and parts, will be sent to you promptly.

CUSTOMER SERVICE DEPARTMENT, E-H RESEARCH LABORATORIES, INC.

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EUROPE: E-H RESEARCH LABORATORIES (NED) N.V. P.O.Box 1018 EINDHOVEN, THE NETHERLANDS
U.K.: E-H RESEARCH LABORATORIES U.K. Ltd COLHAM MILL ROAD, WEST DRAYTON,MIDDLE SEX ENGLAND

3-3 CAPACITORS

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C1	47 μf, ±20%, 20v, Tantalum	318U001
C2	4.7 μf, ±20%, 20v, Tantalum	318U002
C3	.5 μf, ±5%, 200v, Mylar	320U009
C4	.05 μf, ±5%, 200v, Mylar	320U005
C5	.005 μf, ±5%, 500v, Polystyrene	326U004
C6	500 pf, ±10%, 1kv, Ceramic	311U009
C7	.001 μf, ±5%, 500v, Poly.	326U005
C8	25 μf, 25 wvdc, Electrolytic	316U028
C9	.01 μf, ±20%, 600v, Ceramic	311U012
C10	25 μf, 25 wvdc, Electrolytic	316U028
C11	.01 μf, ±20%, 600v, Ceramic	311U012
C12	10 pf, ±10%, 1kv, Ceramic	311U001
C13	100 pf, ±10%, 1kv, Ceramic	311U007
C14	.01 μf, ±20%, 600v, Ceramic	311U012
C15	150 pf, ±10%, 1kv, Ceramic	311U008
C16	.001 μf, ±5%, 500v, Polystyrene	326U005
C17	.01 μf, ±5%, 500v, Polystyrene	326U006
C18	.1 μf, ±5%, 200v, Metalized Myl.	320U007
C19	1 μf, ±5%, 200v, Mylar	320U011
C20	10 μf, ±10%, 20wvdc, Tantalum	318U005
C21	25 μf, 25 wvdc, Electrolytic	316U028
C22	.01 μf, ±20%, 600v, Ceramic	311U012
C23	25 μf, 25 wvdc, Electrolytic	316U028
C24	.01 μf, ±20%, 600v, Ceramic	311U012
C25	25 μf, 25 wvdc, Electrolytic	316U028
C26	.01 μf, ±20%, 600v, Ceramic	311U012
C27	25 μf, 25 wvdc, Electrolytic	316U028
C28	.01 μf, ±20%, 600v, Ceramic	311U012
C29	.001 μf, ±5%, 500v Polystyrene	326U005
C30	.01 μf, ±5%, 500v, Polystyrene	326U006
C31	.1 μf, ±5%, 200v, Metalized Myl.	320U007
C32	1 μf, ±5%, 200v, Metalized Myl.	320U011
C33	10 μf, 20v, Tantalum	318U005
C34	.01 μf, ±20%, 600v, Ceramic	311U012
C35	25 μf, 25 wvdc, Electrolytic	316U028
C36	100 pf, ±10%, 1kv, Ceramic	411U007
C37	150 pf, ±10%, 1kv, Ceramic	311U008
C38	100 pf, ±10%, 1kv, Ceramic	311U007
C39	.001 μf, ±10%, 1kv, Ceramic	311U010
C40	50 pf, ±10%, 1kv, Ceramic	311U006
C41	.01 μf, ±20%, 600v, Ceramic	311U012
C42	25 μf, 25 wvdc, Electrolytic	316U028
C43	.1 μf, +80-30%, 75v, Ceramic	311U014
C44	.1 μf, +80-20%, 500v, Ceramic	311U023
C45	.01 μf, ±20%, 600v, Ceramic	311U012
C46	1 μf, ±5%, 200v, Metalized Myl.	320U011
C47	.01 μf, ±20%, 600v, Ceramic	311U012
C48	.01 μf, ±20%, 600v, Ceramic	311U012
C49	7-100 pf, 250v, Variable, Ceramic	332U003
C50	100 pf, ±10%, 1kv, Ceramic	311U007
C51	.01 ±20%, 600v, Ceramic	311U012
C52	.01 μf, ±20%, 600v, Ceramic	311U012
C53	100 pf, ±10%, 1kv, Ceramic	311U007
C57	.01 μf, ±20%, 600 v	311U012
C101	250 μf, 300 wvdc, Electrolytic	316U040
C102	100 μf, 450 wvdc, Electrolytic	316U008
C103	100 μf, 450 wvdc, Electrolytic	316U008
C104	1 μf, ±20%, 200v, Mylar	320U010
C105	.1 μf, +80-30%, 75 wvdc, Cer.	311U014
C106	250 μf, 12 wvdc, Electrolytic	316U031
C107	500 pf, ±10%, 1kv, Ceramic	311U009
C108	100-100 μf, 350 wvdc, Electrolytic	316U022
C109	4000 μf, 15 wvdc, Electrolytic	316U003
C110	4000 μf, 15 wvdc, Electrolytic	316U003
C111	250 μf, 12 wvdc, Electrolytic	316U031
C112	250 μf, 12 wvdc, Electrolytic	316U031
C113	250 μf, 12 wvdc, Electrolytic	316U031
C114	250 μf, 12 wvdc, Electrolytic	316U031

3-4 DIODES

CR1	1N746A; 3.3v ±5%, 400 mw zener	374U017
CR2	Not used	
CR3	1N751A; 5.1v, ±5%, 400 mw zener	374U022
CR4	1N914B	376U022
CR5	1N270	376U031
CR6	1N270	376U031
CR7	1N746A; 3.3v, ±5%, 400 mw zener	347U017
CR8	1N270	347U031
CR9	1N270	347U031
CR10	1N270	347U031
CR11	CGD1419/1N995	U11742/A
CR12	CGD1419/1N995	U11742/A
CR13	CGD1419/1N995	U11742/A
CR14	1N270	376U031
CR15	CGD1419/1N995	U11742/A
CR16	CGD1419/1N995	U11742/A
CR17	1N270	376U031
CR18	CGD1419/1N995	U11742/A
CR19	1N270	376U031
CR20	Not used	
CR21	CGD1419/1N995	U11742/A
CR22	Not used	
CR23	FD777	U11764
CR24	FD777	U11764
CR25	1N914B	376U022
CR26	1N914B	376U022
CR27	1N914B	376U022

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
Diodes Contd.		
CR28	1.5 M39Z5; 39v, ±10%, 1.5w, zener	374U001
CR29	1N914B	376U022
CR30	1N914B	376U022
CR31	1N270	376U031
CR32	1N270	376U031
CR33	CGD1419/1N995	U11742/A
CR101	1N4005	376U034
CR102	1N4005	376U034
CR103	1N4005	376U034
CR104	1N4005	376U034
CR105	1N4005	376U034
CR106	1N4005	376U034
CR107	1N4005	376U034
CR108	1N4005	376U034
CR109	1N4005	376U034
CR110	1N4005	376U034
CR111	1N753; 6.2v, ±10%, 400mw zener	374U019

3-5 ELECTRON TUBES

V1	7534/E130L, Pentode (Factory Selected)	U10485
V101	6080, Twin Triode	670U017
V102	6080, Twin Triode	670U017
V103	6AU6, Pentode	670U010
V104	6AU6, Pentode	670U010
V105	OA2, Voltage Regulator	670U007
V106	7119, Twin Triode	670U021

3-6 INDUCTORS

L1	Choke 12 μH	U11564
L2	Choke 12 μH	U11564
L3	Choke 12 μH	U11564
L4	Choke 12 μH	U11564
L5	Choke 12 μH	U11564
L6	Choke 12 μH	U11564
L7	Choke 12 μH	U11564
L8	Choke 12 μH	U11564
L9	Filament Choke Assembly	U10558
L10	1.5 μh Choke	335U002
L11	1.5 μh Choke	335U002
L12	1.5 μh Choke	335U002
L13	1.5 μh Choke	335U002

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
	Note: In some instruments metaloxide resistors are fitted instead of carbon comp.	

3-7 RESISTORS

R1	2K, ±5%, 1/2w, carb. comp.	596U202
R2	2.5K, Pot., 10%, 2w, linear taper, composition	550U009
R3	100 Ω, ± 5%, 1/2w, carb. comp.	596U101
R4	10Ω, ±5%, 1/2w, carb. comp.	596U100
R5	180Ω, ±5%, 1/2w, carb. comp.	596U181
R6	10Ω, ±5%, 1/2w, carb. comp.	596U100
R7	150Ω, ±5%, 1/2w, carb. comp.	596U151
R8	200Ω, ±5%, 1/2w, carb. comp.	596U201
R9	1K, ±5%, 1/2w, carb. comp.	596U102
R10	3K, ±5%, 1/2w, carb. comp.	596U302
R11	1 Meg, ±5%, 1/2w, carb. comp.	596U105
R12	22K, ±5%, 1/2w, carb. comp.	596U223
R13	300Ω, ±5%, 1/2w, carb. comp.	596U301
R14	18K, ±5%, 1/2w, carb. comp.	596U183
R15	2.4K, ±5%, 1/2w, carb. comp.	596U242
R16	180Ω, ±5%, 1/2w, carb. comp.	596U181
R17	220Ω, ±5%, 1/2w, carb. comp.	596U221
R18	30K, ±5%, 1/2w, carb. comp.	596U303
R19	75Ω, ±5%, 1/2w, carb. comp.	596U750
R20	750Ω, ±5%, 1/2w, carb. comp.	596U751
R21	330Ω, ±5%, 1/2w, carb. comp.	596U331
R22	430Ω, ±5%, 1/2w, carb. comp.	596U431
R23	180Ω, ±5%, 1/2w, carb. comp.	596U181
R24	51Ω, ±5%, 1/2w, carb. comp.	596U510
R25	1K, ±5%, 1/2w, carb. comp.	596U102
R26	10K, Pot., 10%, 2w, linear taper, composition	550U012
R27	560Ω, ±5%, 1/2w, carb. comp.	596U561
R28	220Ω, ±5%, 1/2w, carb. comp.	596U221
R29	1KΩ, ±5%, 1/2w, carb. comp.	596U102
R30	2K, ±5%, 1/2w, carb. comp.	596U202
R31	300Ω, ±5%, 1/2w, carb. comp.	596U301
R32	330Ω, ±5%, 1/2w, carb. comp.	596U331
R33	430Ω, ±5%, 1/2w, carb. comp.	596U431
R34	750Ω, ±5%, 1/2w, carb. comp.	596U751
R35	75Ω, ±5%, 1/2w, carb. comp.	596U750
R36	51Ω, ±5%, 1/2w, carb. comp.	596U510
R37	160Ω, ±5%, 1/2w, carb. comp.	596U161
R38	1K, ±5%, 1/2w, carb. comp.	596U102
R39	10K, Pot., 10%, 2w, linear taper, composition.	550U012
R40	560Ω, ±5%, 1/2w, carb. comp.	596U561
R41	180Ω, ±5%, 1/2w, carb. comp.	596U181
R42	110Ω, ±5%, 1/2w, carb. comp.	596U111
R43	2K, ±5%, 1/2w, carb. comp.	596U202
R44	10K, ±5%, 1/2w, carb. comp.	596U103
R45	2 Meg, ±5%, 1/2w, carb. comp.	596U205
R46	3.3K, ±5%, 1/2w, carb. comp.	596U332
R47	330Ω, ±5%, 1/2w, carb. comp.	596U331
R48	3.3K, ±5%, 1/2w, carb. comp.	596U332
R49	430Ω, ±5%, 1/2w, carb. comp.	596U431

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
Resistors Contd.		
R50	2K, ±5%, 1/2w, carb. comp.	596U202
R51	22K, ±5%, 1w, carb. comp.	597U223
R52	16K, ±5%, 2w, carb. comp.	598U163
R53	16K, ±5%, 2w, carb. comp.	598U163
R54	56K, ±5%, 1/2w, carb. comp.	596U563
R55	4.3K, ±5%, 1/2w, carb. comp.	596U432
R56	Not used	
R57	33K, ±5%, 2w, carb. comp. (Factory Selected)	598U333
R58	33K, ±5%, 2w, carb. comp. (Factory Selected)	598U333
R59	33K, ±5%, 2w, carb. comp. (Factory Selected)	598U333
R60	500Ω, Pot., 10%, 1/2w, linear taper, composition	550U029
R61	15Ω, ±5%, 1/2w, carb. comp.	596U150
R62	110Ω, ±5%, 1/2w, carb. comp.	596U111
R63	240Ω, ±5%, 2w, carb. comp.	598U241
R64	240Ω, ±5%, 2w, carb. comp.	598U241
R65	240Ω, ±5%, 2w, carb. comp.	598U241
R66	240Ω, ±5%, 2w, carb. comp.	598U241
R67	100Ω, ±5%, 2w, carb. comp.	598U101
R68	100Ω, ±5%, 2w, carb. comp.	598U101
R69	100Ω, ±5%, 2w, carb. comp.	598U101
R70	100Ω, ±5%, 2w, carb. comp.	598U101
R71	240Ω, ±5%, 2w, carb. comp.	598U241
R72	240Ω, ±5%, 2w, carb. comp.	598U241
R73	240Ω, ±5%, 2w, carb. comp.	598U241
R74	240Ω, ±5%, 2w, carb. comp.	598U241
R75	240Ω, ±5%, 2w, carb. comp.	598U241
R76	240Ω, ±5%, 2w, carb. comp.	598U241
R77	13Ω, ±5%, 1w, carb. comp.	597U130
R78	13Ω, ±5%, 1w, carb. comp.	597U130
R79	13Ω, ±5%, 1w, carb. comp.	597U130
R80	12Ω, ±5%, 1w, carb. comp.	597U120
R81	3.3Ω, ±5%, 1w, carb. comp.	597U033
R82	5.1Ω, ±5%, 1w, carb. comp.	597U051
R83	5.1Ω, ±5%, 1/2w, carb. comp.	596U051
R84	82K, ±5%, 1/2w, carb. comp.	596U823
R85	3.9K, ±5%, 1/2w, carb. comp.	596U372
R86	47K, ±5%, 1w, carb. comp.	597U433
R87	1K, ±5%, 1/2w, carb. comp.	596U102
R88	240Ω, ±5%, 2w, carb. comp.	598U241
R89	240Ω, ±5%, 2w, carb. comp.	598U241
R101	30Ω, ±5%, 1w, carb. comp.	597U300
R102	5Ω, 10w, wirewound	610U017
R103	30Ω, ±5%, 1w, carb. comp.	597U300
R104	4K, 10w, wirewound	610U020
R105	62K, ±5%, 1/2w, carb. comp.	596U623
R106	160K, ±5%, 1/2w, carb. comp.	596U164
R107	360K, ±5%, 1/2w, carb. comp.	596U364
R108	100Ω, ±5%, 1/2w, carb. comp.	596U101
R109	22Ω, ±5%, 1/2w, carb. comp.	596U220
R110	30K, ±5%, 1w, carb. comp.	597U303
R111	150K, ±5%, 1/2w, carb. comp.	596U154
R112	50K, Pot., 10%, 2w, Locking, linear taper	545U008
R113	160K, ±5%, 1/2w, carb. comp.	596U164
R114	22Ω, ±5%, 1/2w, carb. comp.	596U220
R115	100Ω, ±5%, 1/2w, carb. comp.	596U101
R116	100Ω, ±5%, 1/2w, carb. comp.	596U101
R117	22Ω, ±5%, 1/2w, carb. comp.	596U220
R118	22Ω, ±5%, 1/2w, carb. comp.	596U220
R119	100Ω, ±5%, 1/2w, carb. comp.	596U101
R120	100K, ±5%, 1/2w, carb. comp.	596U104
R121	51K, ±5%, 1/2w, carb. comp.	596U513
R122	180Ω, ±5%, 1/2w, carb. comp.	596U181
R123	27K, ±5%, 2w, carb. comp.	598U273
R124	10K, ±5%, 1/2w, carb. comp.	596U103
R125	5Ω, 3w, 5%, wirewound	610U003
R126	100K, ±5%, 1/2w, carb. comp.	596U104
R127	160K, ±5%, 1/2w, carb. comp.	596U164
R128	100K, Pot., 10%, 2w, linear taper composition	550U006
R129	150K, ±5%, 1/2w, carb. comp.	596U154
R130	2.7Ω, ±5%, 1w, carb. comp.	597U027
R131	2.7Ω, ±5%, 1w, carb. comp.	597U027
R132	150Ω, ±5%, 1/2w, carb. comp.	596U151
R133	150Ω, ±5%, 1/2w, carb. comp.	596U151
R134	200Ω, Pot., 10%, 1/2w, Miniature, Multiturn, linear taper, wirewound	551U017
R135	510Ω, ±5%, 1/2w, carb. comp.	596U511
R136	510Ω, ±5%, 1/2w, carb. comp.	596U511
R137	510Ω, ±5%, 1/2w, carb. comp.	596U511
R138	510Ω, ±5%, 1/2w, carb. comp.	596U511
R139	750Ω, ±5%, 1/2w, carb. comp.	596U751
R140	510Ω, ±5%, 1/2w, carb. comp.	596U511
R141	15Ω, ±5%, 1/2w, carb. comp.	596U150
R142	511Ω, ±1%, 1/2w, metal film	618U002
R143	475Ω, ±1%, 1/2w, metal film	618U015
R144	100K, ±5%, 1/2w, carb. comp.	596U104
R145	Not used	
R146	39K, ±5%, 2w, carb. comp.	598U393
R147	5K 25 Watt ww	610U031
R148	75K ± 5 o/o 1/2w carb.comp.	596U753
R149	360Ω, nom.1/2w carb.comp.	596U361

3-8 SWITCHES

S1	8 Pos., Single Pole Rotary	624U040
S2	6 Pos., 2 Pole Rotary	624U0014
S3	6 Pos., 2 Pole Rotary	624U0014
S4	2 Pos., 5 Pole Rotary	624U008

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
Switches Contd.		
S5	6 Pos., 2 Pole Rotary	624U004
S6	Pushbutton	635U003
S7	Toggle, DPDT	630U006
S101	Toggle, DPDT	630U006

3-9 TRANSFORMERS

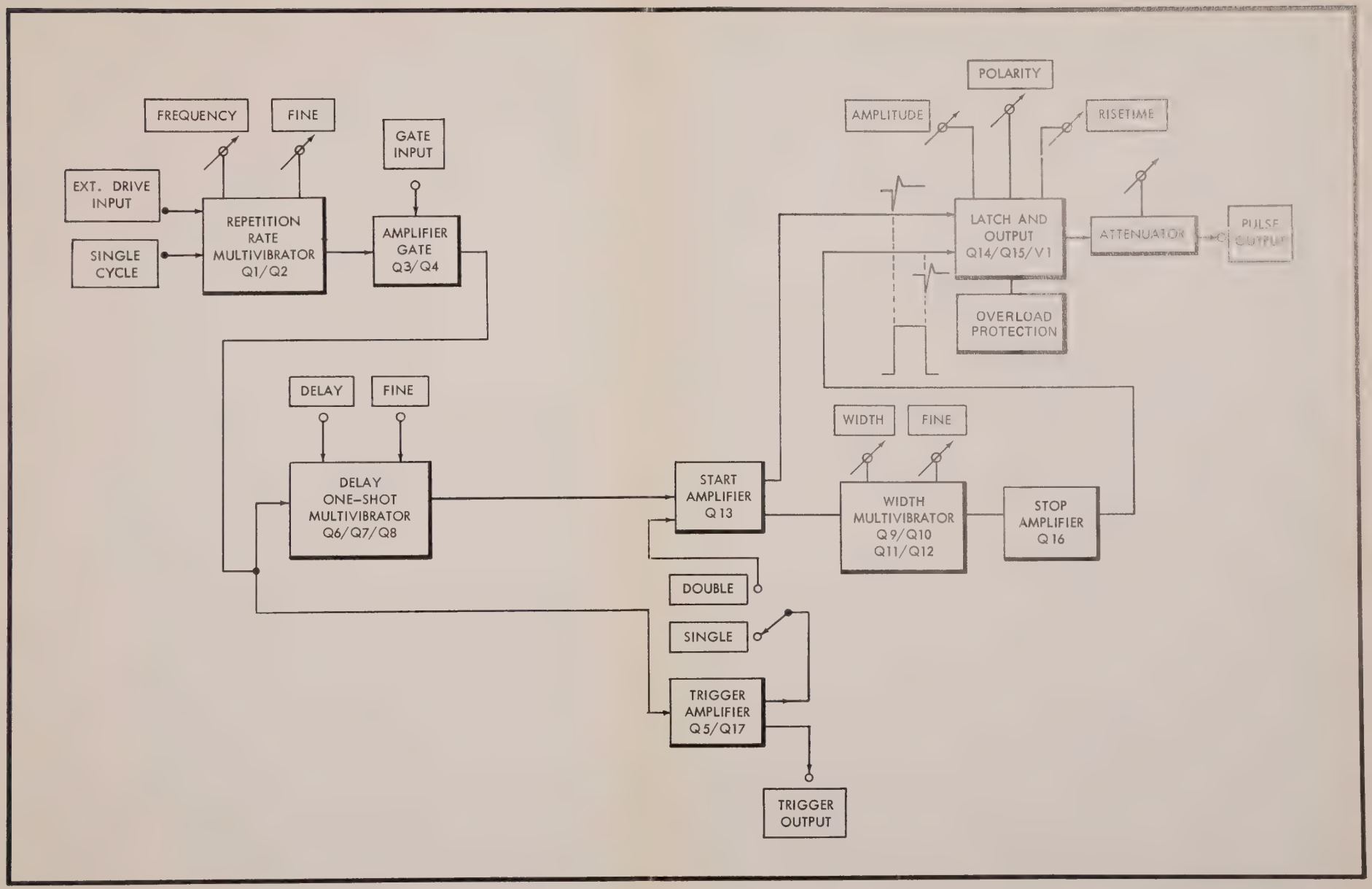
T1	E-H Special Assembly	U10660
T2	E-H Special Assembly	U10661
T3	E-H Special Assembly	UA-10928
T101	Power Transformer	U10560

3-10 TRANSISTORS

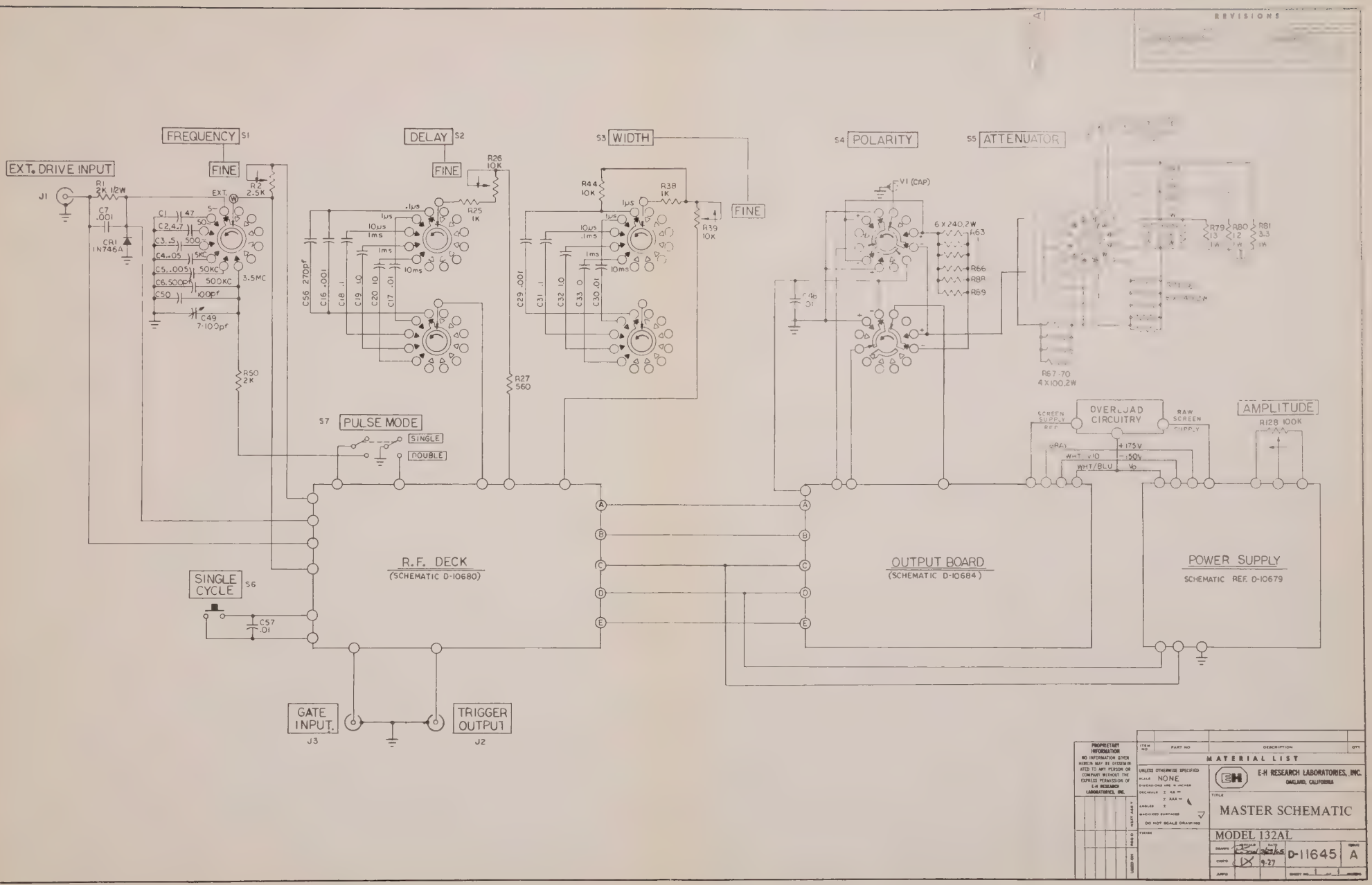
Q1	2N966	663U032
Q2	2N966	663U032
Q3	2N966	663U032
Q4	2N966	663U032
Q5	2N706A	663U022
Q6	2N966	663U032
Q7	2N966	663U032
Q8	2N966	663U032
Q9	2N966	663U032
Q10	2N966	663U032
Q11	2N966	663U032
Q12	2N966	663U032
Q13	2N2369	663U009
Q14	2N3468	663U052
Q15	2N4047	663U096
Q16	2N834	663U028
Q17	2N706A	663U022
Q101	2N1309	663U021
Q102	2N1306	663U018
Q103	2N1309	663U021
Q104	2N250	U11705
Q105	2N250	U11705

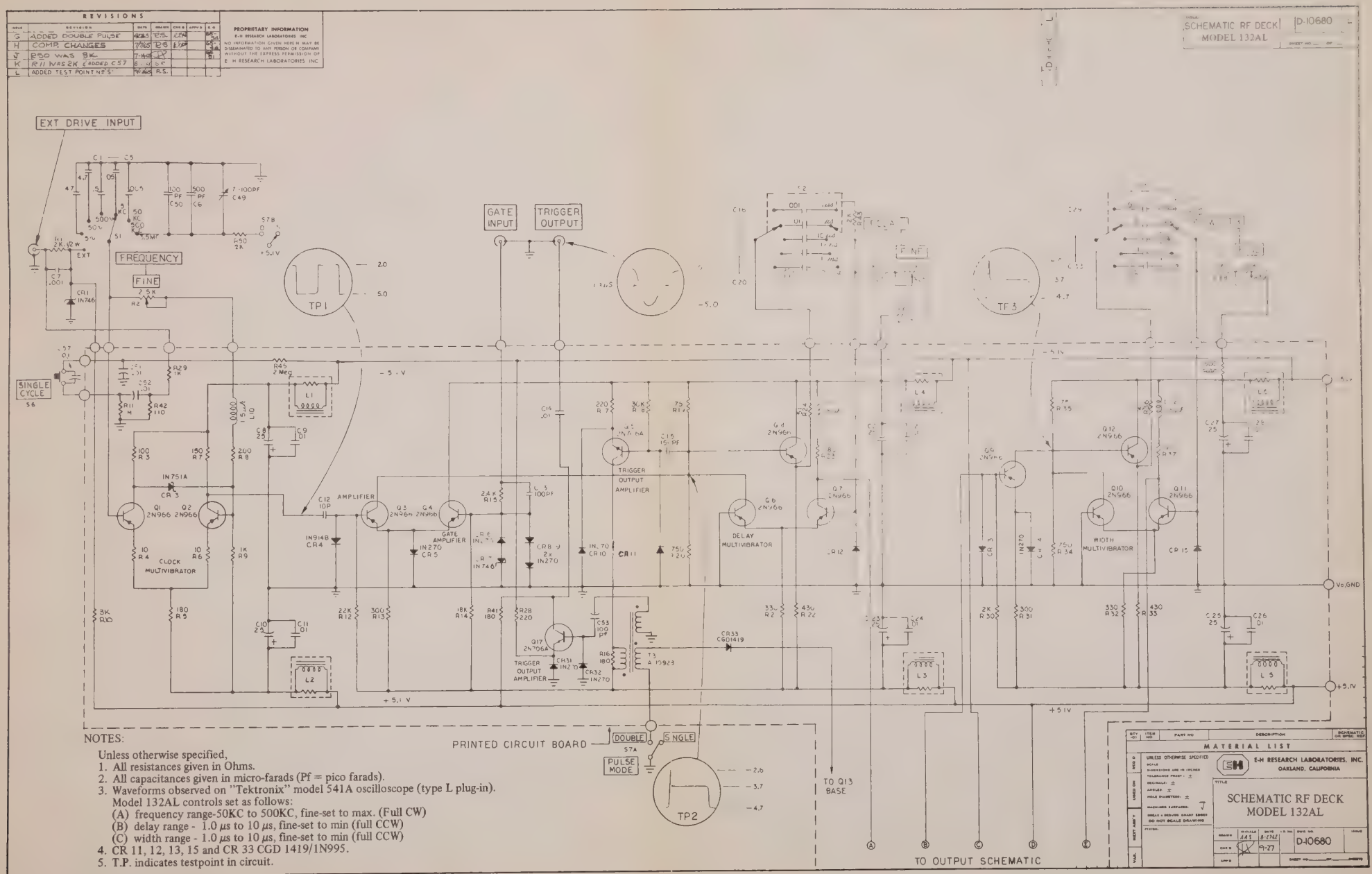
3-11 MISCELLANEOUS

J-1	Connector, BNC UG-1094/U	721U013
J2	Connector, BNC UG-1094/U	721U013
J3	Connector, BNC UG-1094/U	721U013
J4	Connector, BNC UG-1094/U	721U013
	Core, Ferrite (4)	361U002
	Core, Ferrite (1)	361U011
	Fan Blade; 4" 10 Blade clockwise	493U004
	Fan Motor	570U001
	Fan, Venturi Tube	U10322
	Fuse Holder (1)	396U001
F101	Fuse, 3A, Slo-Blo (1)	398U003
F102	Fuse, 1.5A, Slo-Blo (1)	398U013
	Insulator, Electrolytic Capacitor	330U007
	Knob, Large (1)	443U007
	Knob, Medium (4)	443U008
	Knob, Small (5)	443U009
DS1	Pilot Light Assembly, Neon Red	510U008
DS2/58	Neon/reset switch	635U007
	Power Cord (1)	786U001
	Shaft, with Panel Bushing (3)	465U002
	Shaft Couplet (3)	465U001
	Socket, Transistor (4)	490U002
	Socket, Tube, Octal (3)	495U013
	Socket, Tube, 9 Pin Miniature (1)	495U019
K101	Relay 150Ω	584U010



MODEL 132AL PULSE GENERATOR - BLOCK DIAGRAM

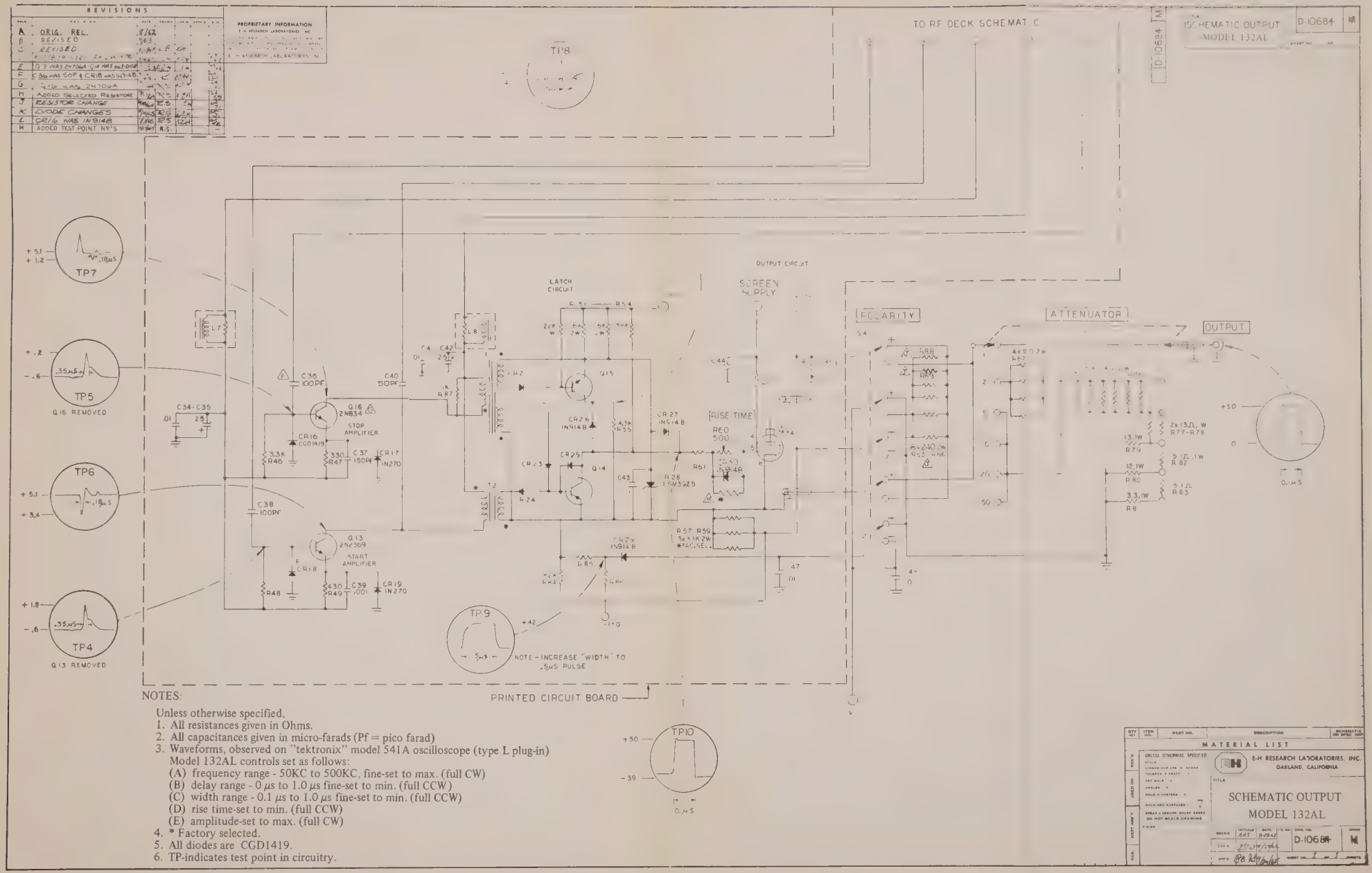

REVISIONS
FREQUENCY S1
FINE
EXT. DRIVE INPUT
J1
R1 2K 12W
R2 2.5K
EXT
C7 .001
CR1 IN746A
C1 47
C2 4.7
C3 .5
C4 .05
C5 .005
C6 500pf
C50 100pf
C49 7-103pf
5MC
50KC
5KC
500KC
3.5MC
R50 2K
DELAY S2
FINE
R26 10K
R25 1K
.1μs
1μs
10μs
1ms
10ms
C56 270pf
C16 .001
C18 .1
C19 1.0
C20 10
C17 .01
R27 560
S3 WIDTH
FINE
R44 10K
R38 1K
R39 10K
C29 .001
C31 .1
C32 1.0
C33 0
C30 .01
S4 POLARITY
V1 (CAP)
6X240,2W
R63
R66
R68
R69
S5 ATTENUATOR
R79 13 1W
R80 12 1W
R81 3.3 1W
R67-70 4X100,2W
S7 PULSE MODE
SINGLE
DOUBLE
OVERLOAD CIRCUITRY
SCREEN SUPPLY REF
RAW SCREEN SUPPLY
+175V
-150V
WHT. v10
WHT/BLU
AMPLITUDE
R128 100K
R.F. DECK
(SCHEMATIC D-10680)
OUTPUT BOARD
(SCHEMATIC D-10684)
POWER SUPPLY
SCHEMATIC REF. D-10679
SINGLE CYCLE S6
C57 .01
GATE INPUT
J3
TRIGGER OUTPUT
J2
A
B
C
D
E
PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.
ITEM NO
PART NO
DESCRIPTION
QTY
MATERIAL LIST
UNLESS OTHERWISE SPECIFIED
SCALE NONE
DIMENSIONS ARE IN INCHES
DECIMALS .X ±.X in
.XX ±.XX in
ANGLES ±
MACHINED SURFACES
DO NOT SCALE DRAWING
FINISH
NEXT ASS'Y
USED ON
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA
TITLE
MASTER SCHEMATIC
MODEL 132AL
DRAWN
DATE 9-27-65
CHK'D
DATE 9-27
APP'D
D-11645
A
SHEET NO



NOTES:

Unless otherwise specified,

1. All resistances given in Ohms.
2. All capacitances given in micro-farads (Pf = pico farads).
3. Waveforms observed on "Tektronix" model 541A oscilloscope (type L plug-in).
   Model 132AL controls set as follows:
   (A) frequency range-50KC to 500KC, fine-set to max. (Full CW)
   (B) delay range - 1.0 μs to 10 μs, fine-set to min (full CCW)
   (C) width range - 1.0 μs to 10 μs, fine-set to min (full CCW)
4. CR 11, 12, 13, 15 and CR 33 CGD 1419/1N995.
5. T.P. indicates testpoint in circuit.



NOTES:

Unless otherwise specified,

1. All resistances given in Ohms.
2. All capacitances given in micro-farads (Pf = pico farad)
3. Waveforms, observed on "tektronix" model 541A oscilloscope (type L plug-in) Model 132AL controls set as follows:
   (A) frequency range - 50KC to 500KC, fine-set to max. (full CW)
   (B) delay range - 0 μs to 1.0 μs fine-set to min. (full CCW)
   (C) width range - 0.1 μs to 1.0 μs fine-set to min. (full CCW)
   (D) rise time-set to min. (full CCW)
   (E) amplitude-set to max. (full CW)
4. * Factory selected.
5. All diodes are CGD1419.
6. TP-indicates test point in circuitry.

MATERIAL LIST

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

SCHEMATIC OUTPUT
MODEL 132AL

D-10684

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APP'D	E.C.
A	ORIGINAL	8/15/65	DAS			
B	REVISED	3/63				
C	C108 WAS 100μf/450V	2-24-66	RK	RWF		66-10
D	ADDED CIRCUITRY IDENT.	3-28-66	R.S.			-
E	ADDED C115 & R147	11-9-66	DL	RK		66-33

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D-10679E

MODEL 132AL POWER SUPPLY D-10679 E

117 VAC
F101 3A
S101 ON
DS1
R144 100K
T101
BLK
BLK/YEL
BLK/GRN
BLK/RED
B101 M

RECTIFIERS
BLUE
IN4005 30, 1W
CR101-102
R101
C103 100 450V
IN4005 5, 10W
CR103
R102
C101 250 300V
RED/YEL
IN4005
CR104
C102 100 450V
IN4005 30, 1W
CR105-106
R103
4K, 10W
R104

BRN 6.3V
BRN
FILAMENTS
6080 6080 6AU6 6AU6 7119
V101 V102 V103 V104 V106
V1 7534 RF. DECK
L9

SERIES REGULATORS
V101 6080
V102 6080
R106 160K
R107 360K
R103 100
R109 22
R114 22
R115 100
R116 100
R117 22
R118 22
R119 100

CONTROL AMPLIFIER
V103 6AU6
R110 30K 1W
C104 1.0 200V
R113 160K
R112 50K "175V ADJUST"
R105 62K

SHUNT REGULATOR & VOLTAGE REFERENCE TUBE
V105 0A2
C115 .25 200V
R147 150
R111 150K

R120 100K
R121 51K
R123 20K 2W
R124 10K
CONTROL AMPLIFIER
V104 6AU6
Q101 2N1309
C105
R122 180
C106 250 12V
5.7K 5W
R125

SERIES REGULATOR
V106 7119
100K R126
C107 500pf
R127 150K
C108A 100 350V
R128 100K AMPLITUDE
R146 39K 2W
150K R129
C108B 100 350V
R149 C115 500, 50V
K101
TS8
SCREEN SUPPLY
R148 75K
R147 5K 25W
DS2
RED
GREEN
WHT/BLU
WHT/VIO. -150V
GRAY +175V

234 VAC
F102 1.5A
S101
R144 100K
DS1
T101
BLK
GRN/YEL
BLK/YEL
BLK/GRN
BLK/RED
B101 M

RECTIFIERS
GRN
IN4005 2.7, 1W
CR107
R130
CR108
C109 4000 15V
C110 4000 15V
CR109
CR110
R131
IN4005 2.7, 1W

R133 150
R132 150
"+5.1V" ADJUST
R134 200
CR111 IN753
R135 510
R139 750
R140 510
Q102 2N1306
CONTROL AMPLIFIERS
Q103 2N1309
R136 510
R137 510
R138 510
Q104 2N250
SERIES REGULATOR
R141 15
Q105 2N250
R142 511
R143 475
C111 250 12V
C112 250 12V
C113 250 12V
C114 250 12V
GREEN +5.1V
VIOLET
WHT/GRN -5.1V

NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCES GIVEN IN OHMS
2. ALL RESISTORS ARE ½W, 5%
3. ALL CAPACITANCES GIVEN IN MICRO-FARAD. (PF = PICO FARADS)

PRIMARY CONNECTION OF TRANSFORMER FOR 234 V AC

MATERIAL LIST

QTY	ITEM NO.	PART NO.	DESCRIPTION	SCHEMATIC OR SPEC. REF

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

MODEL 132AL
POWER SUPPLY

	INITIALS	DATE	D.O. NO.	DWG. NO.	TYPE
DRAWN	DAS	8/15		D-10679	E
CHK'D					
APP'D					

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